Dr. Chance communicated a paper entitled "An analysis of the Fire-damp Explosions in the Anthracite coal mines, from 1870 to 1880."

Mr. Fraley reported that he had received the last installment of the Michaux legacy, amounting to $131.18, and, paid it over to the Treasurer.

And the meeting was adjourned.

An Analysis of the Fire-damp Explosions in the Anthracite Coal Mines, from 1870 *to* 1880. *By H. M. Chance, M. D.*

(*Read before the American Philosophical Society, May* 6, 1881.)

The table which forms the subject matter of this paper is compiled from the reports of the Inspectors of Mines, for the years from 1870 to 1879 inclusive. In it are included all recorded explosions, whether resulting in serious or trivial casualties. The majority of these were caused by the ignition of but a few cubic feet of explosive mixture, but some were terrible disasters, the victims of which may be numbered by scores.

The total number of recorded explosions is 639, the number of casualties 1127, and of these 225 resulted fatally. As the reports for two or three years are not complete, these figures do not represent the exact number of casualties; but they express sufficiently well the ratio between the explosions and the number of miners injured by them.

During these years the explosion of fire-damp was the cause of sixteen per cent. of the total casualties reported by the Inspectors, of eleven per cent. of the fatal accidents and of eighteen per cent. of the non-fatal casualties.

Explosions of Fire-damp.

	1870.	*1871.	1872.	1873.	1874.	†1875.	‡1876.	1877.	1878.	1879.	Total.
January	0	8	3	2	2	3	5	7	2	4	36
February	2	4	4	2	5	3	6	4	1	5	36
March	0	2	6	3	3	3	4	5	0	8	34
April	4	7	14	6	5	2	7	8	2	10	65
May	3	10	8	9	8	1	11	9	2	18	79
June	1	6	7	13	12	5	4	6	4	3	61
July	3	11	5	4	7	7	2	7	4	6	56
August	3	10	13	10	5	3	2	3	6	9	64
September . . .	4	9	6	10	9	12	4	2	0	10	66
October	8	7	10	6	8	6	8	7	2	10	72
November	6	3	2	7	9	5	4	7	2	7	52
December . . .	6	6	3	2	4	9	8	6	4	10	58
Total	40	83	81	74	77	59	65	71	29	100	679

*Explosions in Eastern District of Luzerne, not included in the report for 1871.

†Explosions in Southern District of Carbon and Luzerne, not included in column for 1875.

‡Shamokin District statistics omitted from report for 1876.

The table is arranged to show the number of explosions occuring in each month of the year for ten years, and the right hand column the number for each month of the whole period.

An inspection of latter column shows at once that from April to October the number of explosions is far greater than that of the remaining months of the year. In these seven months 463 explosions are recorded, an average of sixty-six for each month, but for the remaining five months (Jan., Feb., March, Nov. and Dec.) we find but 216 explosions, an average of but forty-three for each of these months.

Temporary or partial suspension of mining during some part of these months in certain years may partly account for this difference, but is inadequate to explain so marked a contrast between the groups of warm and cold months.

It seems probable, that if a closer differentiation could be made, it would be found that many of the explosions occurring during the warm months, happened at or immediately following a short period of unusual warmth, during which the ventilating current was somewhat diminished in strength. At such a time, when unusual warmth with high barometer had existed for one or two days, a sudden fall in the barometric column, presaging a local or general storm would surely be followed by an increased outflow of gas which might readily become explosive at the working face while the air still remained safe in the upcast.*

The low rate of July may be due in part to partial suspension of operations during that month, and the high rates of November and December, high compared to those of January, February and March, are probably due in part to steady working to supply the winter demand, and the low rates of the remaining winter months to partial suspension of work.

The maximum rate in May, and the next in rank, October, are just five months apart. Are these months subject to greater and more sudden and frequent barometric changes than others in this part of the United States?

A list of the most serious colliery disasters in Great Britain, from 1778 to 1866 inclusive, develops the interesting fact that out of forty-five explosions, ten occurred in June and eight in December, periods just six months apart.

The table is as follows:

Months.	*No. of Explosions.*
January	2
February	1
March	4
April	0
May	4

*If one per cent. of gas in the upcast corresponds to a maximum of five per cent. at the working face (in places where "accumulations" are found) an increase of two per cent. in the upcast, making three per cent. in all, a perfectly safe percentage—means an increase to seven per cent. at the working face; a condition of great danger. The above described meteorological conditions may often bring about just such a result.

Months.	*No. of Explosions.*
June	10
July	4
August	3
September	2
October	4
November	3
December	8
Total	45

This list embraces only the explosions resulting in great loss of life. The minimum loss of life was 20, and the maximum, the Oaks Mine disaster, December, 1866, was 362; the loss of life aggregates 2621, an average of more than 58 for each disaster.

The occurrence of three of these explosions on June 2, 1862 (at Washington, Guindræth and Coppal), and two of the most fatal on December 12th and 13th, 1866 (the "Oaks" and "Talk o' the Hill"), by which 362 and 92 lives were lost, certainly point to atmospheric disturbance as the immediate cause. The occurrence of a large percentage of these disasters at semi-annual periods, June and December, seems to indicate the occurrence (in Great Britain) during these months of unusually high barometer, followed by a decided fall, as the probable cause of these great outbursts of gas.

But the problem I have been considering is somewhat different, for the table embraces *all* the explosions, whether large or small, occurring during the ten years. Is shows a decidedly larger number for the warm than for the cold months, and therefore points primarily rather to impairment of ventilation from high temperature than to barometric changes as the true cause of the difference; but the occurrence of two maximum periods, May and October, seems to indicate that barometric changes have also exercised an important influence on the relative efflux of gas.

The *amount* of rise and fall does not seem to have a perceptible effect, for the monthly barometric range is *greatest during the cold months*, whereas fire-damp explosions are most frequent during the warm months. Frequent and *abrupt* changes from high to relatively low barometric pressure, are the probable cause of many explosions, though the movement of the mercury may not amount to more than one-eighth or one-quarter of an inch. An unusually *high* barometric column is always an intimation of coming danger.